DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AIR COMBAT COMMAND
LANGLEY AIR FORCE BASE, VIRGINIA

OFFICE OF THE COMMANDER
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NOV 05 2009

MEMORANDUM FOR ACC/JA

SUBJECT: Accident Investigation Board Report: F-15E, T/N 90-0231, 366 EFS, 455 AEW, near Ghazni, Afghanistan, 18 July 2009

I have reviewed the Accident Investigation Board Report regarding the F-15E, T/N 90-0231, that impacted the ground while participating in a combat mission, approximately 30 miles west of Ghazni, Afghanistan on 18 July 2009. The report prepared by Brigadier General H.D. Polumbo, Jr. complies with the requirements of AFI 51-503 and is approved.

William J. Rew

WILLIAM J. REW
Lieutenant General, USAF
Vice Commander

Attachment:
Accident Investigation Board Report

EXECUTIVE SUMMARY
AIRCRAFT ACCIDENT INVESTIGATION

F-15E, T/N 90-0231
BAGRAM AIRFIELD, AFGHANISTAN
18 JULY 2009

On 18 July 2009, at 0233 local time (L), an F-15E aircraft, tail number 90-0231, impacted the terrain 30 miles west of Ghazni, Afghanistan, while participating in a combat mission. The mishap aircraft (MA) was based at Bagram Airfield, and assigned to the 336th Expeditionary Fighter Squadron. The mishap pilot (MP) and mishap weapon systems officer (MW) died upon impact. The MA was destroyed. Financial loss of the MA and other government property totaled $55,373,351.90. No other injuries or damage resulted from the mishap.

The mishap crew (MC) was part of a two-ship F-15E flight. The mishap flight (MF) departed Bagram Airfield at 2237L to begin a close air support (CAS) mission. At 0209L, they completed the CAS mission. The MF delayed their return to base to practice high angle strafe (HAS), an air-to-surface attack firing 20 millimeter rounds (firing is simulated on practice attacks). The MF selected a strafe target area where they routinely practiced HAS. While en route to the target area, the flight lead (FL) referenced control panels in their cockpits to determine the mean sea level (MSL) elevation of the intended target. The FL assessed the intended target elevation as 4,800 feet (ft). The MF calculated a 6,000 ft minimum safe altitude and open and cease fire altitudes of 8,500 and 7,500 ft for their HAS attack. All flight members were flying with night vision goggles. The FL called for low illumination attack parameters.

The MF arrived at the target area at 0220L. Multiple displays in both front and rear cockpits showed the elevation of the intended target as approximately 10,200 ft MSL. Neither crew noticed the 5,000 ft discrepancy in the previously assessed target elevation. The MF prepared to practice HAS based on the 4,800 ft MSL elevation. The FL initiated their attack first. During the attack, the FL realized that they were at too low of an attack angle and aborted. Next, the MC initiated their attack. The MP lowered the nose of the MA at 18,000 ft and achieved the correct HAS attack angle. The airspeed of the MA was approximately 470 knots calibrated airspeed. The MC continued on their attack for approximately 10 seconds until impact. There was no attempt to recover the aircraft, and neither the MP nor the MW attempted to eject.

The Accident Investigation Board (AIB) President found by clear and convincing evidence that the cause of the mishap was the flight lead weapon systems officer's incorrect assessment of the target elevation and the mishap crew's reliance on this inaccurate number. These actions resulted in calculating open and cease fire altitudes below the actual ground level of the target. Additionally, the AIB President found five factors that substantially contributed to the mishap: misperception of the operational conditions in the target area; an erroneous expectation for a typical night strafing attack; inexperience by the flight lead and the mishap crew at executing night strafing; channelized attention; and an improper cross check during the attack.

SUMMARY OF FACTS AND STATEMENT OF OPINION
F-15E, T/N 90-0231
18 JULY 2009

TABLE OF CONTENTS

COMMONLY USED ACRONYMS AND ABBREVIATIONS

ADI	Attitude Directional Indicator
AEF	Air Expeditionary Force
AETC	Air Education and Training Command
AFTO	Air Force Technical Order
AFB	Air Force Base
AFI	Air Force Instruction
AFIP	Air Force Institute of Pathology
A/G	Air-to-Ground
AFPAM	Air Force Pamphlet
AFSC	Air Force Specialty Code
AFTTP	Air Force Tactics, Techniques and Procedures
AGE	Aerospace Ground Equipment
AIB	Aircraft Investigation Board
AMU	Aircraft Maintenance Unit
ASD	Average Sortie Duration
AUX	Auxiliary
AWACS	Airborne Warning and Control System
BINGO	Minimum Fuel Required to Head Home
BPO/PR	Basic Post or Pre-Flight Inspection
CAS	Close Air Support
CC	Commander
CSAR	Combat Search and Rescue
Dash-1	T.O. 1F-15E-1, F-15E Flight Manual
DO	Director of Operations
DPI	Desired Point of Impact
DTED	Digital Terrain Elevation Data
EFS	Expeditionary Fighter Squadron
ER	Exceptional Release
FCIF	Flight Crew Information File
FL	Flight Lead
FLP	Flight Lead Pilot
FLW	Flight Lead Weapons System Officer
FOM	Facilitate Other Maintenance
FS	Fighter Squadron
FTU	Flying Training Unit
G	Force of Gravity
GCWS	Ground Collision Warning System
HAS	High Angle Strafe
HAT	Height Above Target
HUD	Heads up Display
IAW	In Accordance With
Illum	Illumination
IMDS	Integrated Maintenance Data System
IR	Infrared
K	Thousand
KCAS	Knots Calibrated Airspeed
L	Local time
MA	Mishap Aircraft
MAJCOM	Major Command
MDS	Mission Design Series
ME	Mishap Engine
MF	Mishap Flight
MP	Mishap Pilot
MPD	Multi-Purpose Display
MQT	Mission Qualification Training
MSA	Minimum Safe Altitude
MSL	Mean Sea Level
MW	Mishap Weapon Systems Officer
NM	Nautical Miles
NOTAMS	Notices to Airmen
NTISR	Non-Traditional Intelligence, Surveillance and Reconnaissance
NVGs	Night Vision Goggles
Ops Group	Operations Group
Ops Tempo	Operations Tempo
OSC	On-Scene Commander
PA	Public Affairs
PGM	Precision Guided Munitions
Pipper	Aircraft Gun Aiming Reference
PRD	Pilot Reported Discrepancy
PRO SUPER	Production Supervisor
QA	Quality Assurance
QC	Quality Check
QUAL	Qualification
RALT	Radar Altimeter
RMM	Removable Memory Module
RTB	Return to Base
SIB	Safety Investigation Board
SLR	Slant Range
S/N	Serial Number
Sortie	Flight
TCI	Time Change Inspection
TCTO	Time Compliance Technical Order
TH	Thru-Flight Inspection
T/N	Tail Number
T.O.	Technical Order
TR	Training Rule
TSD	Tactical Situation Display
USAF	United States Air Force
WSO	Weapon Systems Officer
Z	Zulu or Greenwich Mean Time

The above list was compiled from the Summary of Facts, the Statement of Opinion, the Index of Tabs, and Witness Testimony (Tab V).

SUMMARY OF FACTS

1. AUTHORITY, PURPOSE, AND CIRCUMSTANCES

a. Authority

On 11 August 2009, Major General Roger A. Binder, Acting Vice Commander, Air Combat Command (ACC), appointed Brigadier General H.D. Polumbo, Jr., to conduct an aircraft accident investigation of a mishap that occurred on 18 July 2009 involving an F-15E aircraft, tail number (T/N) 90-0231, in Eastern Afghanistan (AFG). (Tab Y-3 thru Y-4) The investigation was conducted at Langley Air Force Base (AFB), Virginia (VA), from 22 August 2009 through 11 September 2009. Technical advisors were Lieutenant Colonel Matthew McCall (Medical), Major Mark Schmidt (Pilot), Captain Jason R. Smith (Legal), Captain Aaron Yager (Maintenance), 1st Lieutenant Christopher Reichlen (Physiologist), and Technical Sergeant Jesse Bascombe (Recorder). (Tab Y-3 thru Y-4)

b. Purpose

The purpose of this investigation is to provide a publicly releasable report of the facts and circumstances surrounding the mishap, to include a statement of opinion on the cause or causes; to gather and preserve evidence for claims, litigation, disciplinary, and adverse administrative actions; and for other purposes. This report is available for public dissemination under the Freedom of Information Act (Title 5, United States Code, Section 552).

c. Circumstances

The accident board was convened to investigate the Class A mishap involving an F-15E aircraft, T/N 90-0231, assigned to the 336th Expeditionary Fighter Squadron (EFS), 455th Air Expeditionary Wing (AEW), Bagram Airfield, which occurred during a combat mission on 18 July 2009.

2. ACCIDENT SUMMARY

On 18 July 2009, at 0233 hours local time (L), 2203 Greenwich Mean/Zulu time (Z), an F-15E aircraft, T/N 90-0231, crashed 30 miles west of Ghazni, AFG, while participating in a combat mission. (Tab C-3) The mishap aircraft (MA) was based at Bagram Airfield and assigned to the 336 EFS. (Tab C-3) The mishap pilot (MP), Captain Mark R. McDowell, and the mishap weapon systems officer (WSO) (MW), Captain Thomas J. Gramith, were deployed from Seymour Johnson AFB, North Carolina. (Tab B-3) The mishap sortie began as a close air support (CAS) mission. (Tabs K-6, AA-5) After completing the CAS mission, the mishap flight (MF) began their return to Bagram Airfield. (Tab N-3) The MF delayed their return to practice high angle strafe (HAS) attacks. (Tab N-4) During the MC's first practice HAS attack, the MA impacted the ground. (Tab B-3) The mishap crew (MC) made no attempt to recover the aircraft or eject and died upon impact. (Tab J-11, N-12, N-13) The MA was destroyed. (Tab P-3) Financial loss of the MA and other government property totaled $55,373,351.90. (Tab P-3) No other injuries or damage resulted from the mishap. (Tabs B-3, P-3)

3. BACKGROUND

The MA was assigned to the 336 EFS. (Tab B-3) At the time of the mishap, the 336 EFS was deployed from Seymour Johnson AFB, North Carolina, and was temporarily assigned to the 455 AEW. (Tab B-3) The 336 EFS is designated as the 336th Fighter Squadron (FS) when operating at its home station. (Tab CC-5) The 336 FS falls under the 4th Fighter Wing, which is part of ACC. (Tab CC-5)

a. 455th Air Expeditionary Wing

The 455 AEW is comprised of more than 4,000 Airmen with approximately 1,300 personnel based at Camp Cunningham, Bagram Airfield. The wing consists of the 455th Expeditionary Operations Group, 455th Expeditionary Mission Support Group, 455th Expeditionary Maintenance Group, 455th Expeditionary Medical Group, 755th Air Expeditionary Group and 451st Air Expeditionary Group (located at Kandahar). The wing serves United States (U.S.) Air Forces Central by providing close air support; combat search and rescue; aerial intelligence, surveillance and reconnaissance; and airlift capabilities to U.S. and coalition forces supporting Operation ENDURING FREEDOM (OEF). Aircraft include the A-10 Thunderbolt II, F-15E Strike Eagle, F-16C Fighting Falcon, C-130 Hercules, HH-60 Pave Hawk, Navy EA-6B Prowler, MQ-1 Predator and MQ-9 Reaper. (Tab CC-3, CC-4)

b. 336th Expeditionary Fighter Squadron "Rocketeers"

The 336 FS became the first operational F-15E Strike Eagle squadron in the Air Force in October 1989. The Rocketeers have deployed in support of Operation DESERT SHIELD, Operation DESERT STORM and most recently OEF. In August 2009 the 336 EFS surpassed 8,000 combat hours in the F-15E. (Tab CC-5 thru CC-7)

c. F-15E Strike Eagle

The F-15E Strike Eagle is a dual-role fighter designed to perform air-to-air and air-to-ground missions. An array of avionics and electronics systems gives the F-15E the capability to fight at low altitude, day or night, and in all weather.

The aircraft is flown by two aircrew members, a pilot and a WSO. In the rear cockpit, the WSO has a multi-purpose display (MPD) that includes four screens that display information from the radar, electronic warfare or infrared sensors; monitor aircraft or weapons status and possible threats; select targets; and use an electronic "moving map" to navigate.

The aircraft has a low-altitude navigation and targeting infrared for night (LANTIRN) system which allows it to fly at low altitudes, at night and in any weather conditions, to attack ground targets with a variety of precision-guided and unguided weapons. The LANTIRN system gives the F-15E unequaled accuracy in weapons delivery day or night and in poor weather, and consists of two pods attached to the exterior of the aircraft. Also, the aircraft has a targeting pod that contains a laser designator and a tracking system that marks targets at long ranges.

For air-to-ground missions, the F-15E can carry most weapons in the Air Force inventory, and it has an internally mounted 20 millimeter (mm) gun that can carry up to 500 rounds. (Tab CC-12)

4. SEQUENCE OF EVENTS

a. Mission

The mishap sortie was planned as a two-ship CAS combat mission in support of OEF. (Tabs K-3, K-6, AA-5) OEF CAS missions are generally 3-5 hours in duration and include non-traditional intelligence, surveillance, and reconnaissance (NTISR) and precision guided munitions (PGM)/strafe employment in support of friendly forces, often with troops in contact (TIC) with enemy forces. Missions can rapidly change from relatively benign NTISR to weapons employment in a TIC situation.

The MF, call sign Dude 13, was comprised of a flight lead (FL), call sign Dude 13, and a wingman, call sign Dude 14. The FL consisted of the flight lead pilot (FLP) and the flight lead WSO (FLW). The MC was the wingman to the FL and consisted of the MP and the MW. (Tab AA-5)

b. Planning

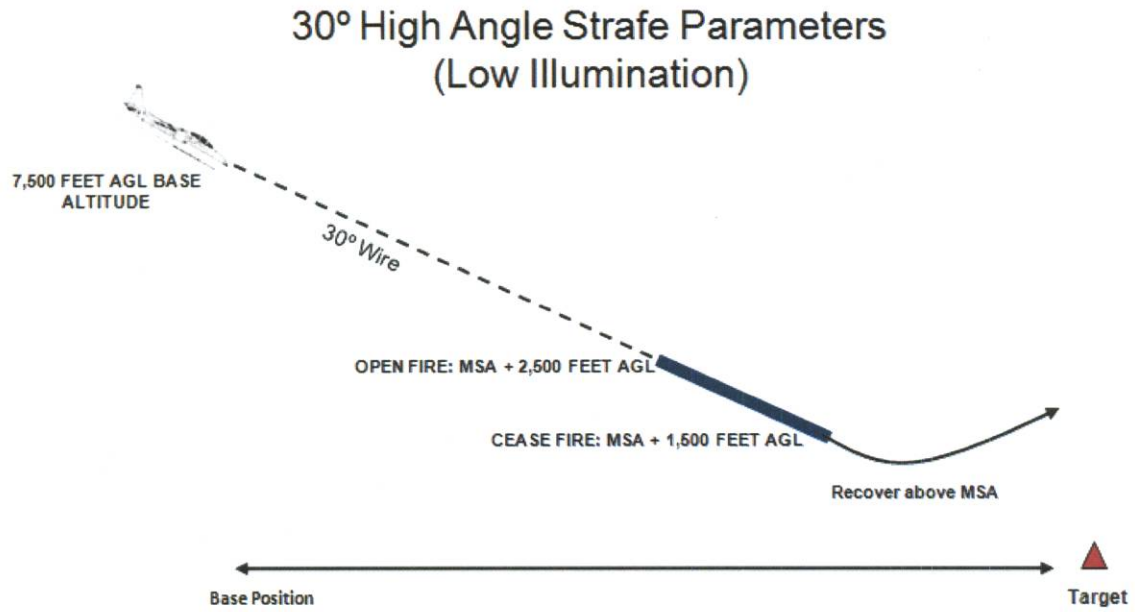
At approximately 1925 L, the MF accomplished their mission planning which included signing the appropriate forms to fly; reviewing mission materials provided to them by the Mission Planning Cell; reviewing maps of the area of responsibility (AOR) and potential surface-to-air threats; receiving intelligence and Ground Liaison Officer briefs; and checking weather and Notices to Airman (NOTAMs). (Tabs K-7 thru K-16, AA-5)

The MF began their mission brief at approximately 1940L. (Tab AA-5) The FL briefed both administrative topics and tactics. The administrative brief covered basic ground operations, taxi, take-off, departure, air-to-air refueling, and recovery procedures. (Tab BB-9, BB-10) The tactical brief focused on the AOR, Joint Terminal Attack Controller (JTAC) call signs and frequencies, and weapons employment tactics, including HAS. (Tab BB-9, BB-10) HAS is an air-to-surface attack at greater than 15 degrees nose low and firing 20mm rounds. (Tab AA-19) On a HAS attack, the line from the aircraft to the target is referred to as the "wire."

The MF planned to operate under low illumination conditions for most of the mishap sortie. (Tab W-1) Illumination forecast data is calculated by adding sky glow from the setting or rising sun, moon and star illumination. Since strafing was anticipated, the MF knew they might be flying at low altitudes. When flying low altitude at night with low illumination (less than 2.2 millilux), the minimum safe altitude (MSA) is an altitude of 1,000 feet above the highest obstacle/terrain (rounded up to the next 100 feet) within a designated area. (Tab B-4, B-5) For low illumination conditions, it is difficult to see terrain through night vision goggles (NVGs), so an MSA based on average terrain elevation in a defined area is used to avoid collision with the terrain.

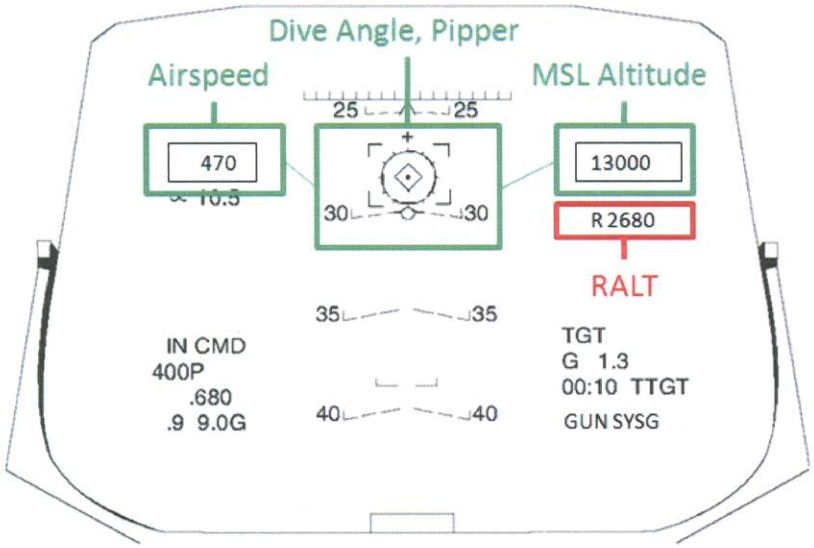
The attack illustration below depicts the recommended low illumination HAS attack to achieve desired weapons effects and safely recover (pull up) above the MSA. The acceptable dive angle for night strafe is 20 to 35 degrees. (Tab AA-20) For low illumination HAS, open and cease fire

altitudes are calculated by adding 2,500 feet and 1,500 feet to the MSA. After ceasing fire, aircrews recover their aircraft above MSA. (Tab AA-16, AA-19, AA-24)



When aircrews fly a low illumination HAS attack it requires a different cross check than for other strafe attacks. During most strafe attacks, the cross check consists of dive angle, pipper (aiming reference) on target, slant range to target, and airspeed. If slant range to the target is not available, then the aircrew aborts the attack at a designated above ground level (AGL) altitude. The radar altimeter (RALT) displays provide the aircrew AGL altitude. For low illumination HAS attacks, the cross check is dive angle, pipper on target, airspeed, and mean sea level (MSL) altitude. (Tab V-5.2) RALT and slant range are not used as backup references for low illumination HAS. (Tab AA-16)

SAMPLE HUD DEPICTION DURING STRAFE ATTACK



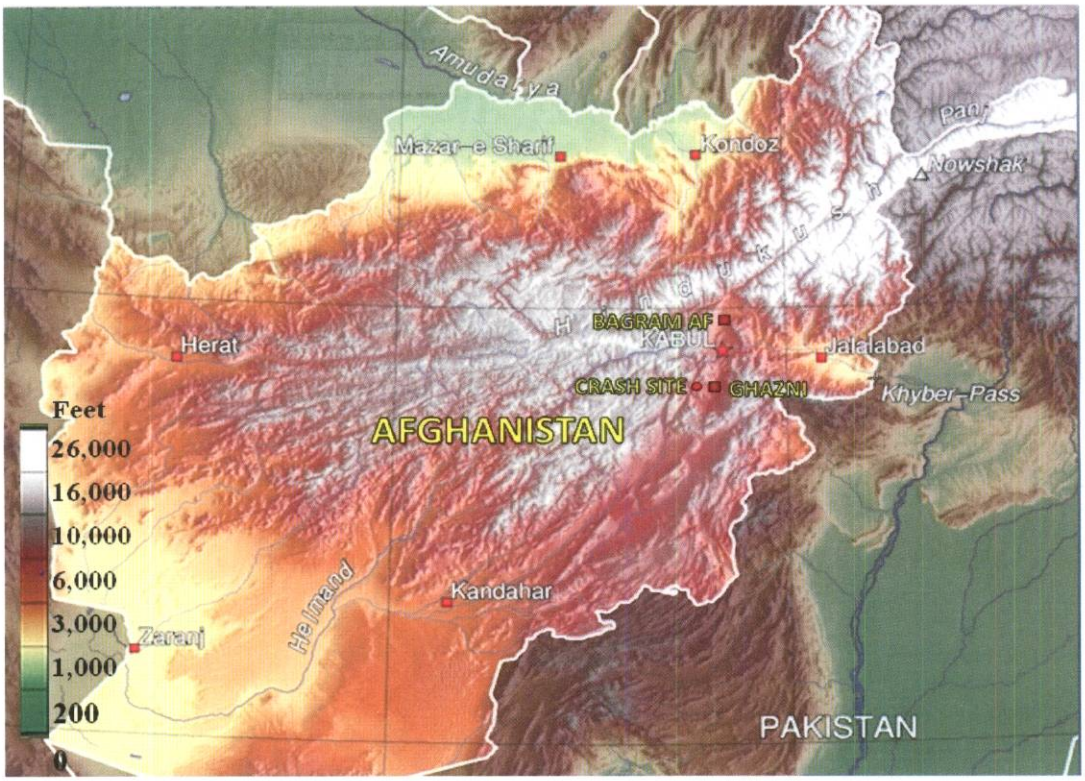
c. Preflight

The MF members received a step brief including weather, NOTAMs, and aircraft status update, and then stepped to their respective aircraft at 2025L. (Tab AA-5) Prior to departure, the maintenance crew chief and the MC accomplished preflight inspections on the MA. The MF members boarded their respective aircraft at approximately 2120L, and the expected time of departure was 2140L. (Tab AA-5) Maintenance members discovered low air pressure on the MA's nose landing gear tire. Departure was slightly delayed to correct this discrepancy. (Tab D-11) No discrepancies were noted that prevented the MA from being fully mission capable. (Tab D-4)

d. Summary of Accident

Start, taxi, and takeoff were unremarkable. The MF departed Bagram Airfield at 2237L. The CAS portion of the mishap sortie was uneventful. During this portion of the mission, the MF air-to-air refueled twice.

At 0209L the MF finished the CAS mission and started their return to Bagram Airfield. (Tabs L-3, N-3) The FLW set steering in the tactical situational display (TSD) to Bagram Airfield. (Tabs L-3, N-3) The TSD is a presentation of aircraft position in relation to a planned mission route superimposed over a digital map. The TSD screen displayed an elevation of approximately 4,800 ft MSL for Bagram Airfield. (Tab L-3) The FLP then asked the FLW to assess the elevation for the dry lake bed located 30 miles west of Ghazni. (Tabs L-3, N-4, V-1.5) The dry lake bed was one of the places designated by the 336 FS director of operations for practicing HAS, and aircrew routinely practiced at this location. (Tabs V-1.3, V-1.4, AA-6) The dry lake bed has an average terrain of approximately 10,000 ft and is surrounded by mountains with peaks that range from 13,000 to 16,000 ft MSL.



The FLW switched screen modes in the TSD and moved the cursors to the dry lake bed. (Tabs N-4, V-2.5, V-2.6) It took only a few seconds to move the cursors. (Tab L-3) After the FLW moved the cursors to the dry lake bed, the TSD screen displayed "DTED [Digital Terrain Elevation Data] NOT AVAILABLE." (Tab L-3) This meant that the aircraft did not have terrain elevation information in the database for that specific point. Since information must be manually uploaded into the TSD system for each point and there are thousands of points in a particular area, it is possible that some points do not have data available in the TSD. WSOs are aware of this, and the solution is to move the cursors slightly to another point where information is available. The FLW told the FLP the average terrain for the dry lake bed was 4,800 ft MSL. (Tab N-4) When the AIB asked how he arrived at his attack parameters for the dry lake bed, the FLW recalled the TSD displaying an elevation in the 4000s. (Tab V-2.4) The FLW and FLP used the TSD as their sole means of deriving the average terrain for the dry lake bed. (Tabs N-4, V-2.5, V-2.6) A warning in the F-15E Flight Manual provides, "Height Above Terrain (HAT) information on the TSD should not be used for absolute altitude reference for terrain avoidance or terrain clearance." (Tab BB-21)

Both aircraft had the correct target elevation displayed on multiple screens in each cockpit including the heads up display (HUD) and targeting pod, which they used as primary sensors, for the final ten minutes before the mishap. (Tab L-3) Based on the 4,800 ft elevation of the target, the FLP set an MSA of 6,000 ft MSL. (Tabs N-4, V-1.5) This was 5,000 ft less than the correct MSA and 4,200 ft below ground level. The FLP then directed use of low illumination HAS numbers. (Tab N-5) The MC acknowledged the numbers and calculated the open and cease fire MSL altitudes. (Tab N-5)

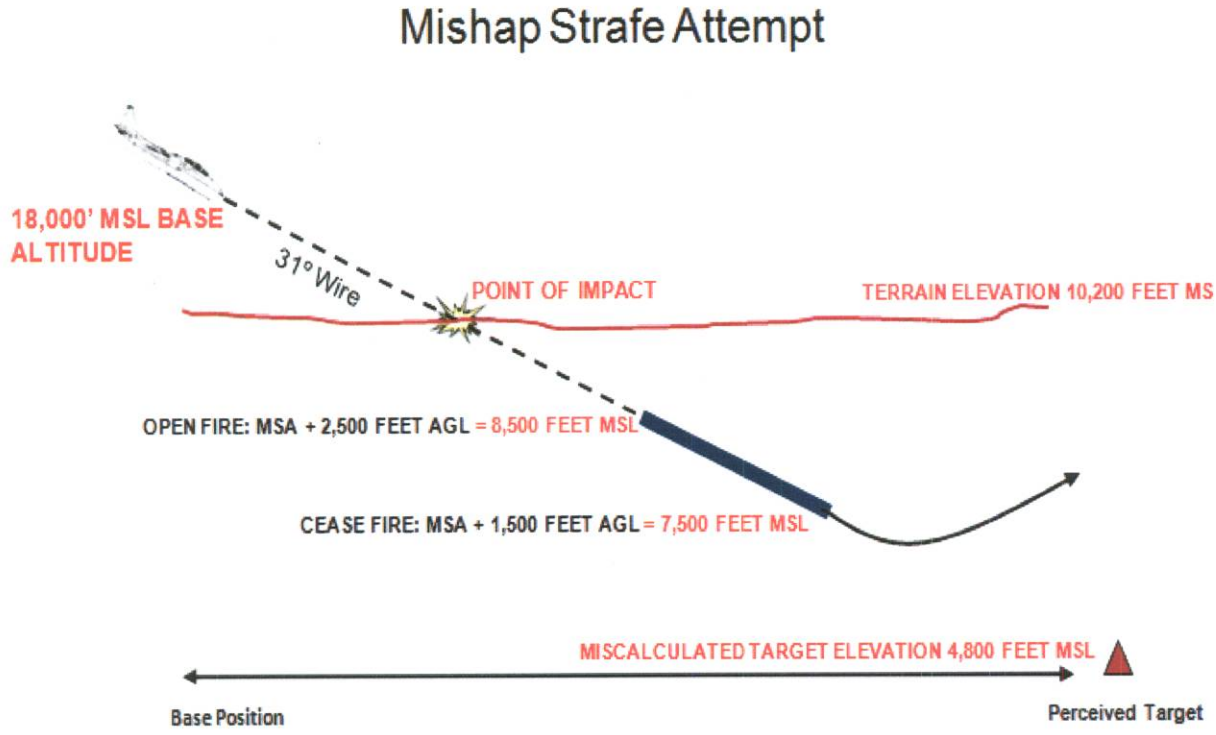
At 0220L the MF arrived at the dry lake bed and began searching for the intended targets using the targeting pod and NVGs. (Tabs L-3, N-6 thru N-8) The MF referred to the intended targets as "islands." (Tab N-7) The "islands" were mounds of dirt 10 to 20 ft round and 7 ft high. (Tab S-14 thru S-17) The FL searched for five minutes and could not locate the islands he expected to see from previous daytime sorties. (Tab N-6 thru N-8, V-1.4) The MF circled the dry lake bed two more times before finding them on the targeting pod video. (Tab L-3)

At 0230L the FL asked all flight members if they were "comfortable" executing the practice strafe attack. (Tab N-12) The flight lead is responsible for the safe conduct of all operations by each member of the formation. Wingmen are expected to follow the leader's direction unless they ask for clarification on any portion of the flight leader's guidance. Wingmen are also expected to verify data and attack parameter calculations during formation flying. Instead of verifying the target elevation data, the MP replied, "Sure", thereby indicating he was comfortable with the attack as planned. (Tab N-8)

At 02:31:30L the MP reconfirmed with the MW the open and cease fire altitudes of 8,500 ft MSL and 7,500 ft MSL. (Tabs L-3, N-12) The MW illuminated the target with the infrared (IR) marker, and the MP confirmed visual of the IR marker at 02:31:36L. (Tabs L-3, N-12) Next, the MP maneuvered the MA to a base altitude and distance from the target to setup for the HAS attack. (Tab L-3) While the MC turned to their base position, the FL began their attack. (Tab L-3, N-9) During their attack, the FL realized they were shallow (too low of an attack angle) and aborted their attack. (Tab N-9) The MC announced their intent to begin their attack

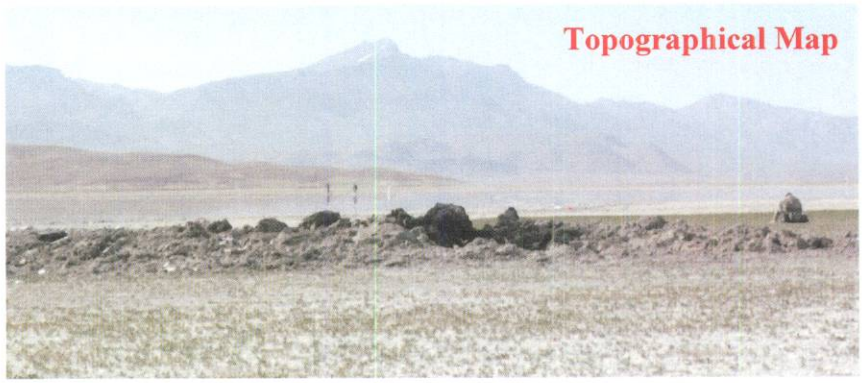
at 02:33:03L. (Tab N-9) At 02:33:19L the FLP informed the MC of their aborted attack due to being shallow. Additional information was not provided regarding his aborted attack. (Tab N-9)

The MC began their descent toward the perceived target at 02:33:42L. (Tab L-3) The MC achieved a 31 degree dive angle and continued their dive until impact. (Tab L-3) Three seconds before impact, the ground collision warning system (GCWS) alerted the MC to "pull up" four times and a large arrow pointing up displayed in the MPDs and the HUD. (Tabs L-3, N-13) The GCWS warns aircrews of impending controlled flight into terrain. It is a passive warning system that does not have automatic recovery. (Tab BB-21)

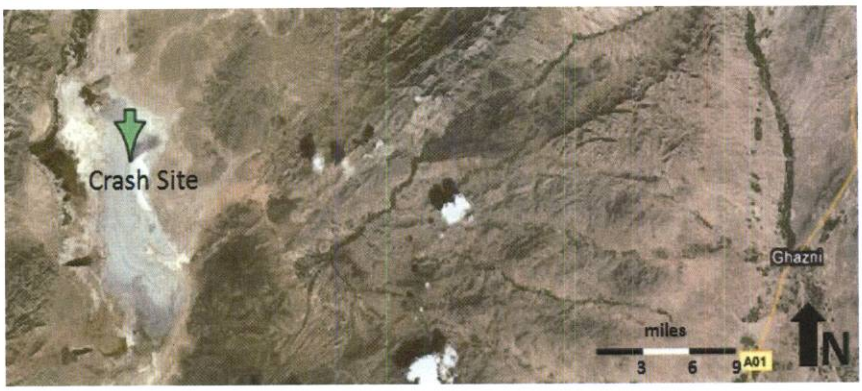


e. Impact

The MA impacted the ground at 02:33:52L. The MC died upon impact. (Tab B-3) The MA was destroyed. (Tab B-3, P-3) The value of the MA was $49,721,970, and other government property was $5,651,381.90. (Tab P-3 thru P-6) No other injuries or damage resulted from the mishap. Three seconds prior to impact, the flight parameters were approximately 470 knots



calibrated airspeed, 1,100 feet AGL, 31 degrees nose low, and descent rate of 420 feet per second. (Tabs H-3, L-3, S-3 thru S-19) Analysis of the G-suits and recovered flight videos indicate the MC made no attempt to recover. (Tab J-10, L-3)



f. Life Support Equipment, Egress and Survival

Analysis of egress system components indicates that neither the MP nor the MW attempted to eject. (Tab J-6) None of the ejection sequence mechanisms examined displayed evidence of activation. (Tab J-6) The records and analysis of life support and survival equipment did not reveal any deficiencies relevant to the mishap. (Tabs H-5, O-3 thru O-22)

g. Combat Search and Rescue (CSAR)

At 0234L, the FL notified the proper authorities of the mishap and provided coordinates of the crash site. (Tab N-9, classified report) The FL assumed initial on-scene commander duties (OSC) until they were relieved at 0245L by another F-15E, call sign Dude 15. (classified report) At 0325L an A-10, call sign Hog 71 assumed OSC duties. (classified report)

A Quick Reaction Force (QRF) arrived at the crash site approximately one hour after the mishap. The QRF secured the perimeter and initiated CSAR and wreckage recovery. (classified report) Five hours later, U.S. Army pathfinders replaced the QRF and continued CSAR efforts. (classified report)

h. Recovery of Remains

CSAR personnel recovered the MW and MP's remains from the crash site. (classified report) The Air Force transported the remains to Dover AFB, Delaware. (Tab X-3) The Armed Forces Institute of Pathology (AFIP) conducted DNA testing on the remains and positively identified them as the remains of the MW and the MP. (Tab X-3)

5. MAINTENANCE

All relevant paper and electronic records indicate that maintenance actions performed on the MA prior to the mishap sortie were completed in accordance with applicable Air Force technical orders, instructions, procedures and directives. There is no evidence to suggest that maintenance performed on the MA contributed to the mishap.

a. Forms Documentation

The Air Force Technical Order (AFTO) 781 series of forms and the Integrated Maintenance Data System (IMDS) collectively document maintenance and provide historical record of inspections, servicing, configuration, status, and flight records. AFTO 781 forms are hard copy paper records maintained in a forms binder called the active forms. At the end of the flying period, the

completed forms are removed from the aircraft's active binder and stored in a jacket file along with all other aircraft historical data.

The active forms and historical documents for the 90 days preceding the mishap revealed no recurring maintenance problems, open discrepancies, time change items, overdue or pending Time Compliance Technical Orders that contributed to the mishap. (Tab D-4 thru D-30)

b. Inspections

The major scheduled inspection cycle for the F-15E is the 400-hour phase inspection program. The phase inspection is completed by a dedicated inspection team composed of highly trained crew chiefs and specialists. It consists of removing panels, components and inspecting aircraft structure and sub-systems for damage, wear, and correct operation. The MA's last phase inspection was completed on 19 March 2009 with 6,071.7 flight hours on the airframe. Prior to the mishap, the MA accumulated an additional 352.7 hours for a total of 6,424.4 total flight hours and was 53.7 hours away from its next scheduled phase inspection due at 6,478.1 hours. (Tab D-4, D-16)

In addition to phase inspections, there are several periodic and/or minor aircraft systems and equipment inspections required at various intervals. The periodic inspections are tracked in the AFTO 781K forms, Section C (Calendar and Hourly Inspection Schedule). There were no periodic inspections overdue for the MA at the time of the mishap. (Tab D-16) Maintenance personnel completed several minor inspections on the MA prior to the mishap.

The MA flew once on the morning of 17 July 2009 before the mishap sortie. Before this flight, several inspections were performed. At 0730L the assigned crew chief completed the combined Basic Post Flight and Pre-Flight (BPO/PR) inspection. (Tab D-4) It consisted of a visual verification of proper fuel, hydraulic, and pneumatic servicing, and a physical inspection of the external airframe structure, including flight controls, landing gear and canopy. The inspection revealed that the nose landing gear tire pressure was low. It was appropriately serviced. (Tab D-11) A Production Supervisor performed the Exceptional Release (ER), confirming the forms were documented correctly and that the MA was safe for flight. (Tab D-4) The crew chief performed the launch inspection which verified aircraft systems fluid levels and correct operating parameters with aircrew in the cockpit and engines running. (Tab D-4 thru D-6) The MA taxied to the End-of-Runway (EOR), where a crew performed the final inspections required before every flight and just before takeoff. (Tab D-4) Maintenance personnel verified there were no fuel or hydraulic leaks, unsecured panels or doors, or cut tires, and that the appropriate safety pins were removed and flight controls surfaces were operational and in the correct position. (Tab D-4) At the same time, a weapons crew checked loaded munitions for security and armed them. (Tab D-10, D-11) After this sortie, the MA returned "Code 1," a landing status code indicating the MA had no mechanical problems that required maintenance. (Tab D-33) The MA taxied back to its parking spot, and the inspection cycle started over again.

Before the mishap sortie, additional inspections were performed. Immediately preceding the mishap sortie there was a Thru-Flight (TH) inspection. The TH inspection is required between flights on the same day and was completed by the assigned crew chief at 2015L, 17 July 2009. (Tab D-4) The MP inspected the aircraft forms and signed the ER as required. The crew chief performed the launch inspection, followed by the EOR crew, which performed the final EOR

inspection just before take-off. All inspections performed prior to the mishap were completed in accordance with applicable Air Force technical orders and no maintenance problems were identified that were relevant to the mishap.

The MA was fitted with two Pratt and Whitney F-100-PW-220 engines, and these engines have their own inspection requirements. The major inspection for F-100-PW-220 engine is the 400-hour phase inspection, which includes an overhaul. The last overhaul on Mishap Engine 1 (ME1, left engine) was completed on 7 January 2009. The last overhaul on Mishap Engine 2 (ME2, right engine) was completed on 8 January 2009. Both ME1 and ME2 were installed in the MA on 20 January 2009. (Tab D-3) Maintenance personnel also conduct hourly borescope inspections on the installed engines at the 100, 200, 400 and 1200 hour marks. All required borescope inspections were current at the time of the mishap. (Tab D-21, D-23) The last scheduled inspection performed was the 200 hour borescope inspection. Both ME1 and ME2 were inspected on 8 June 2009 and no defects were noted. (Tab D-3)

c. Maintenance Procedures

There is no evidence to indicate the maintenance procedures of the 336th Expeditionary Aircraft Maintenance Unit were related to the mishap.

d. Maintenance Personnel and Supervision

The individual training records, Air Force (AF) Form 623; Job Qualification Standards, AF Form 797; Special Certification Roster; and associated maintenance documentation indicate personnel who performed maintenance on the MA were properly trained and possessed the skill level, qualifications and expertise required to perform assigned tasks.

There is no evidence that the training, expertise, or supervision of personnel performing assigned tasks on the MA contributed to the mishap.

e. Fuel, Hydraulic and Oil Inspection Analysis

Maintenance personnel took oil samples from the MA between the first sortie on 17 July 2009 and the mishap sortie. The samples revealed the oil was acceptable for continued service. (Tabs D-44, U-3) It was not possible to obtain engine oil, hydraulic fluid, or fuel samples from the crash site for testing. Immediately following the mishap, the aerospace ground equipment most recently used to service the MA was isolated for testing. All samples taken were analyzed and found to be within the acceptable serviceable range. (Tab D-45 thru D-48) Records indicate the MA was refueled twice during the mishap sortie by aerial refueling tanker aircraft; therefore, it was deemed unnecessary to test jet fuel samples from ground servicing trucks.

There is no evidence to suggest fuel, hydraulic or oil fluids contributed to the mishap.

f. Unscheduled Maintenance

The MA flew a total of 79 combat sorties during its deployment to Bagram Airfield. Of those 79 sorties the aircrew documented 42 as Code 1; 27 as Code 2 (minor discrepancies that required maintenance but were not safety of flight issues or prevented continued flights on the aircraft); and 10 as Code 3 (maintenance was required before the MA could fly again). All Code 3 discrepancies were remedied before the MA was returned to service. The most recent Code 3 prior to the mishap occurred on 9 July 2009 when the aircrew reported they received a caution light indicating low air flow coming from the environmental control system. The problem was

caused by a bad final stage valve, which was subsequently replaced. (Tab D-33) The MA flew 13 sorties in the 8 days prior to the mishap without any significant mechanical problems.

There is no evidence to suggest that any unscheduled maintenance action contributed to the mishap.

6. AIRCRAFT AND AIRFRAME

a. Condition of Systems and Structures

The MA's high rate of speed at impact resulted in destruction of the airframe and substantial destruction of its components. (Tabs H-3, S-13 thru S-20) Due to limited survivability of aircraft components and location of the crash site, recovery of wreckage was minimal. The recovered components were returned to Bagram Airfield. (Tab Q-12 thru Q-16)

b. Repair and Testing Stations

The Removable Memory Module (RMM) was recovered from the crash site and sent to the 846th Test Support Squadron at Eglin AFB, Florida, for data recovery. 29 of 33 memory chips in the RMM were intact with recoverable data. The recoverable data was extracted and combined into streaming audio and video segments from the MA's cockpits. (Tabs L-3, N-10 thru N-13, EE-3, EE-4)

Parts of the MA's Egress System were sent to the Aerospace Engineering Systems Group at Brooks-City Base, Texas, for testing. The parts were disassembled and inspected for signs of damage, malfunction, and initiation of ejection sequence. (Tab J-3 thru J-6)

Forward and aft hydraulic manifolds, which are part of the horizontal stabilator control system, were recovered and sent to the Boeing Failure Analysis Laboratory in St. Louis, Missouri, for tear down analysis. (Tab EE-5 thru EE-19) The purpose was to determine the position of the horizontal stabilator flight control surfaces at the time of impact. (Tab I-3 thru I-8)

c. Functionality of Equipment

Maintenance documentation and post flight analysis indicate all mechanical and electrical systems required for flight were operating within specifications prior to impact. No aircraft anomalies were found to have contributed to the mishap.

7. WEATHER

a. Forecast Weather

There were no weather advisories or warnings for takeoff or departure. The forecast for takeoff was few clouds at 12,000 ft MSL, 9,000 meters visibility and winds from the south at 12 knots. (Tab F-5) The forecast for the assigned working area was variable winds, 9,000 meters visibility, haze and few clouds at 8,000 ft MSL. (Tab F-5) Sunset was at 1906L and moonrise at 0028L. (Tab F-3) End evening nautical twilight was 2010L. (Tab F-5) Forecast illumination was low (less than 2.2 millilux) from 2130L until 0230L. (Tab W-3)

There was no significant weather forecast for the mishap area around 0230L. Forecast winds were variable at 6 knots. (Tab F-5)

b. Observed Weather

Ghazni is the closest meteorological reporting station to the crash site. (Tab N-6) At the time of the mishap, the observed weather at Ghazni was clear skies with unrestricted visibility and winds from the northeast at 4 knots. (Tab F-7) The changeover from low to high illumination occurred at 0226L. (Tab N-5, W-1) The FL was able to distinguish terrain features through their NVGs from their position at 18,000 ft MSL. (Tab N-8)

c. Conclusion

The mission was flown within operational weather limitations.

8. CREW QUALIFICATIONS

F-15E aviators are required to fly several different types of sorties and events to maintain their skill level and proficiency. As a fighter squadron prepares to deploy to support combat operations, a tailored "spin-up" program is developed to focus on expected in-theater missions and the required skill sets necessary to execute those missions. (Tabs V-3.3, V-4.1, AA-27) The 336 EFS prepared a detailed and robust program which included a list of flying events and academics for each member to complete prior to deploying to Afghanistan. (Tab T-5, V-3.3, V-4.1) Of note, each crew member was required to accomplish 14 events in night HAS before deploying. (Tab T-5) The MP and the MW completed all of their night HAS events prior to deploying. (Tab T-5)

In addition to the pre-deployment training, the 336 EFS developed a program focused on HAS for in-theater use. (Tab AA-6) Before implementing the program, the F-15E HAS subject matter expert briefed the 336 EFS on HAS in mountainous terrain. (Tab AA-7 thru AA-13) The MP had 5 practice night HAS strafe events between 29 June 2009 and 9 July 2009. (Tab AA-3) The MW had 6 practice night HAS events between 7 July and 15 July 2009. (Tab AA-4) All of the MP and MW's practice HAS events were during high illumination conditions. (Tab AA-3, AA-4, classified scheduling information) The mishap sortie was the first time during this deployment that the MP and MW accomplished night HAS during low illumination conditions.

a. Mishap Pilot (MP)

The MP was a current and qualified F-15E pilot with 468.6 total hours military flying time, all in the F-15E, with 139.7 hours flying at night and 115.7 hours flying with NVGs. (Tab G-17, G-26) Since he had less than 500 hours in the F-15E, he was an inexperienced F-15E pilot by Air Force standards. Prior to this deployment, he had not flown any combat sorties. His squadron commander recognized him as an above average wingman on his way to early upgrade to flight lead status. (Tab V-3.2)

The MP completed his mission qualification check in the F-15E on 1 August 2008, and he completed his initial instrument qualification check on 13 February 2009. He was rated "Qualified" on both his instrument and mission check rides. (Tab T-4)

Mishap Pilot	Hours	Sorties
Last 30 Days	67.0	17
Last 60 Days	136.8	36
Last 90 Days	202.6	52

(Tab G-5)

b. Mishap WSO (MW)

The MW was a current and qualified F-15E WSO with 337.6 total hours military flying time, all in the F-15E, with 81.7 hours flying at night and 72.5 hours flying with NVGs. (Tab G-26, G-36) Since he had less than 500 hours in the F-15E, he was an inexperienced F-15E WSO by Air Force standards. Prior to this deployment, he had not flown any combat sorties. His squadron commander recognized him as someone who always strove for perfection. (Tab V-3.2)
On 20 February 2009, the MW completed his mission qualification check in the F-15E and was rated "Qualified." (Tab T-3) The MW received additional supervision before the deployment because he had some difficulty learning to prioritize tasks during critical phases of flight. (Tab V-3.2, V-3.3, V-4.1)

Mishap WSO	Hours	Sorties
Last 30 Days	71.1	18
Last 60 Days	138.0	34
Last 90 Days	182.5	45

(Tab G-25)

c. Flight Lead Pilot (FLP)

The FLP was a current, qualified, and experienced F-15E pilot with 455.4 hours in the F-15E, and 1534.9 hours total military flying time. (Tab G-45) The FLP had 134.4 hours flying at night and 121.2 hours flying with NVGs. (Tab G-56) The FLP completed his two-ship flight lead upgrade on 3 March 2009. (Tab G-41) The FLP was one of the newest flight leads in the 336 EFS, with only one month of flight lead experience prior to deploying to Bagram Airfield.

d. Flight Lead WSO (FLW)

The FLW was a current, qualified, and experienced F-15E WSO with 810.2 hours total military flying time, all in the F-15E. (Tab G-66) The FLW had 247.6 hours flying at night and 230.4 hours flying with NVGs. (G-78) The FLW completed his instructor WSO upgrade 2 weeks prior to deployment but had no actual instructor time in the F-15E. (Tab G-66)

9. MEDICAL

a. Qualifications

All MF members were medically qualified to perform flying duties for the mishap sortie. A current AF Form 1042, *Medical Recommendation for Flying*, was in each of the MF member's medical records, and each was marked as "medically cleared for flying."

b. Health

The MP had no medical waivers recorded in the Aeromedical Information Management Waiver Tracking System. He reported excellent health on his Pre-Deployment Health Assessment, Department of Defense (DD) Form 2795, dated 27 March 2009.

The MW had an indefinite aeromedical waiver for childhood asthma. He had no symptoms or treatment for this since age 14, but the Air Force requires a waiver for this medical condition before a person is permitted to fly. The MW twisted his ankle on 30 June 2009 and was temporarily placed on 'duties not including flying' status. He approached medical personnel to report improvement and indicated he was ready to return to flying status. He was evaluated at

the Flight Medicine clinic and medically cleared for flying on 3 July 2009. The MW was seen for back pain during navigator training in July 2007. He was treated non-surgically and returned to full duty for completion of his training. The last documented visit or treatment for complaints of back pain was in September 2007. A medical waiver was not required for this medical condition. He reported excellent health on his Pre-Deployment Health Assessment, DD Form 2795, dated 27 March 2009.

The FLP had a Flight Physical current through 25 November 2009. He reported excellent health on his Pre-Deployment Health Assessment, DD Form 2795, dated 31 March 2009.

The FLW had a flight physical current through 21 November 2009. He reported excellent health on his Pre-Deployment Health Assessment, DD Form 2795, dated 27 March 2009.

Squadron medical personnel and fellow airmen reported no observed physical or emotional issues with any of the MF within the preceding 72 hours prior to the mishap sortie. (Tab V-1.2, V-2.2)

c. Toxicology

The autopsy and forensic studies performed by the AFIP determined the cause of death for the MP and the MW was blunt trauma. Toxicological studies were performed on the MF and ten maintenance personnel who recently worked on the MA. Toxicological reports revealed no alcohol, illegal substances or prohibited medications were present in any of the personnel tested. Carbon monoxide levels were also found to be normal. (Tab DD- 22 thru DD-33)

d. Lifestyle

There is no evidence to suggest lifestyle factors were relevant to the mishap.

e. Crew Rest and Crew Duty Time

Aviators are required to have proper "crew rest" prior to performing in-flight duties. Crew rest is defined as a minimum 12-hour non-duty period before the designated flight duty period begins. During this time, an aircrew member may participate in meals, transportation or rest as long as he or she has the opportunity for at least eight hours of uninterrupted sleep. (Tabs BB-13)

The squadron flight surgeon was familiar with the MC's activities and reconstructed a 72-hour and 14-day history of the MC. This was supplemented by observations provided by members in the squadron. The histories of the MC and the FL indicate that all aircrew complied with crew rest and flight duty period requirements. (Tab DD-20, DD-21)

10. OPERATIONS AND SUPERVISION

a. Operations

At the time of the mishap, the 336 EFS was engaged in 24-hour combat operations in order to meet Combined Air Operations Center (CAOC) tasking on the Air Tasking Order (ATO). The CAOC is a command and control agency responsible for matching air and space missions from the joint forces commander with available assets in theater. The ATO is a computerized product sent to deployed units directing their daily tasking. The 336 EFS was very busy, but it was operating at a typical pace for a deployed fighter squadron at Bagram Airfield.

b. Supervision

Supervision at the squadron, group, and wing level was appropriate and fully engaged. (Tab V-3.2, V-4.1) The MP and the MW were trained and ready to accomplish the assigned mission. (Tab G-3 thru G-40, T-5 thru T-9)

A squadron read file (SRF) was issued by the 336 EFS commander 20 days prior to the mishap requiring aircrew to practice HAS on both day and night missions. (Tab AA-6) All aircrew in the squadron were required to review the SRF before stepping to fly. (Tab AA-6) Additionally, the F-15E strafe subject matter expert briefed all aircrew on how to safely execute night air-to-ground strafe for both high and low illumination conditions and the inherent hazards associated with night strafe. (Tab AA-7 thru AA-13) The SRF and academics were intended to focus the squadron on the safe and tactical employment of the F-15E in a dynamic combat environment like Afghanistan.

11. HUMAN FACTORS

The Department of Defense Human Factors Analysis and Classification System lists and defines potential human factors that may be present in a mishap. Human factors can be present on four general levels: Organizational Influence, Supervision, Preconditions, and Acts. The following defines and discusses human factors relevant to this mishap.

Misperception of Operational Conditions

Misperception of operational conditions is a factor when an individual misperceives or misjudges altitude, separation, speed, closure rate, road/sea conditions, aircraft/vehicle location within the performance envelope or other operational conditions, and this leads to an unsafe situation.

The MC misperceived the operational condition of target elevation. After the CAS mission, the MF planned to practice HAS using low illumination attack parameters. The MF calculated attack parameters based on an incorrect target elevation of 4,800 ft MSL, which yielded open and cease fire altitudes of 8,500 ft MSL and 7,500 ft MSL respectively. Actual target elevation was approximately 10,200 ft MSL. Thus, the MF planned to open and cease fire below the terrain.

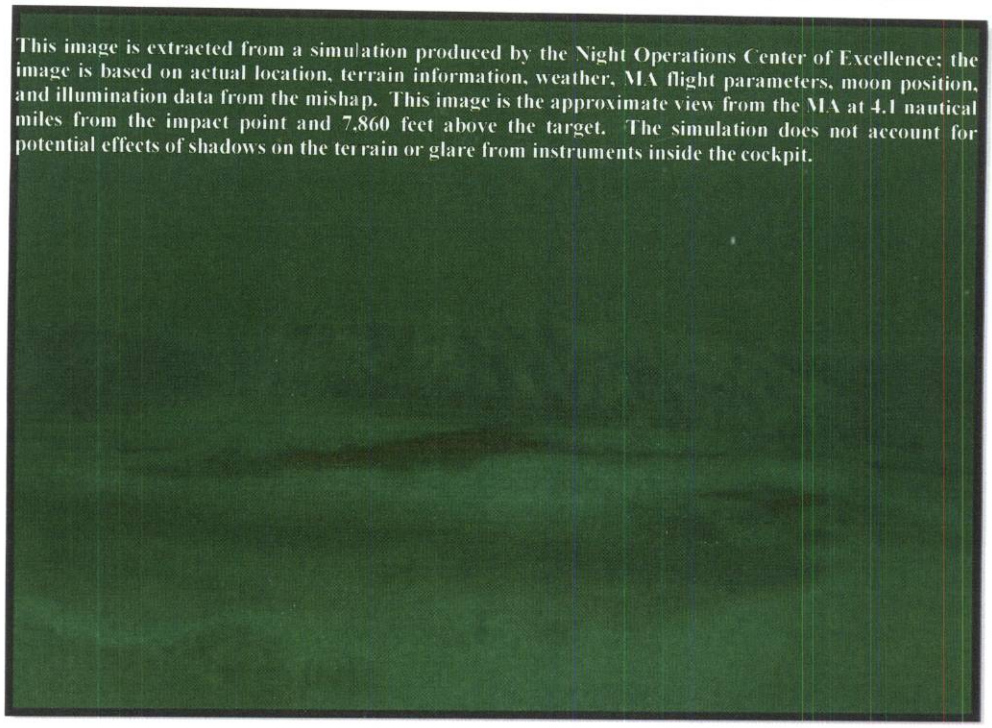
All flight members were wearing night vision goggles (NVGs). NVGs provide environmental visual cues at night not available with unaided vision, but still lack important qualities of daytime vision, such as visual acuity and depth perception. They use near-infrared radiation to produce a representation of the visual scene on a phosphor screen and rely on several characteristics of the visual scene for image quality. The terrain can appear farther away than it actually is when any of the following are low: illumination, terrain contour, scene detail, or variance in albedo (reflectance) of the terrain.

Between the time the MF calculated attack parameters and the time of impact, the illumination levels increased from 1.9 millilux to 2.3 millilux. Any value less than 2.2 millilux is considered low illumination, so the MF operated close to the nominal threshold. (Tab BB-4) Also, the terrain around the target area was relatively low contrast, due to its flat consistent contours and absence of vegetation or other distinguishing detail. These conditions can degrade the ability to

visually perceive distance. This can lead to aircrews overestimating their height above the terrain.

The FL described a "washed out" image immediately following their aborted strafe attack. (Tab N-9) The moon was behind both aircraft on the final attack heading, but potentially in the field of view prior to turning final. Thus, the MC may have experienced some visual distortion immediately preceding or during their attack.

Simulated NVG Scene at the Dry Lakebed from 18,000 ft MSL



Channelized Attention

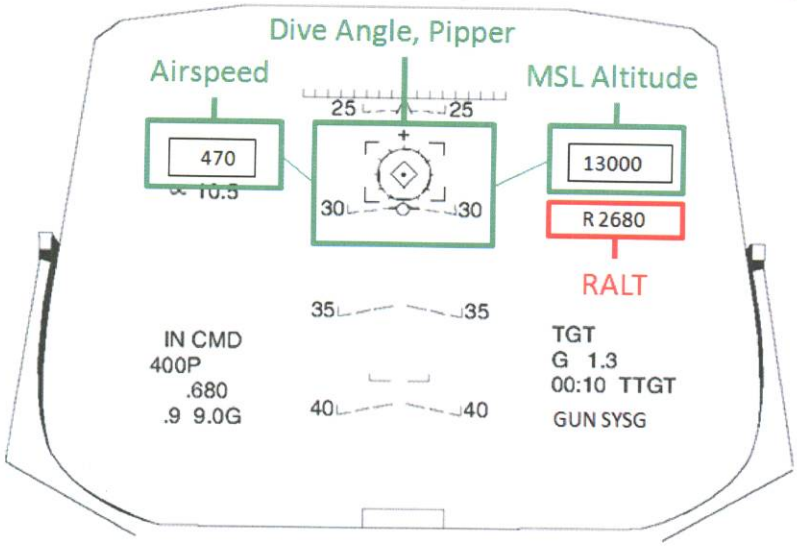
Channelized attention is a factor when the individual is focusing all conscious attention on a limited number of environmental cues to the exclusion of others of a subjectively equal or higher or more immediate priority, leading to an unsafe situation. Channelized attention may also be described as a tight focus of attention that leads to the exclusion of comprehensive situational information.

There were several sources of information available to the MC on final that could have prevented impact, including flight instruments, environmental visual information, and visual and aural warning provided by the GCWS.

Vision is the most reliable sense in flight. The human visual system operates in two modes: focal and ambient (peripheral). The focal mode, approximately the central 30 degrees, is under conscious control and detects fine detail and color, perceives depth, and is primarily responsible for object recognition. During the attack, the MC used focal vision to process HUD information and distance estimation cues from the terrain. All of these tasks require conscious processing,

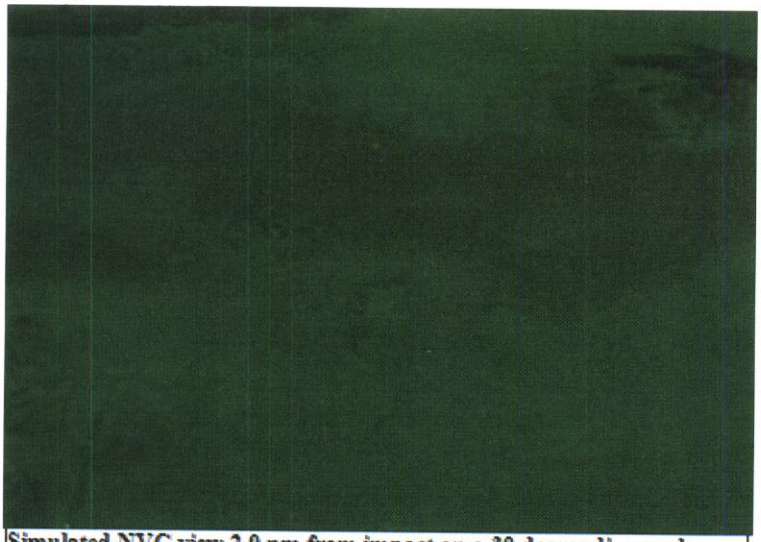
which can only occur in sequence at a limited speed, necessitating a prioritized cross check of pertinent information. (Tab DD-3, #2, 5) Cross check items for flying low illumination HAS attacks are airspeed, MSL altitude, dive angle, and pipper placement. Slant range and RALT are not included in the cross check. Correct attack parameters ensure terrain clearance.

Depiction of HUD on 30 degree HAS (Key Information Highlighted)

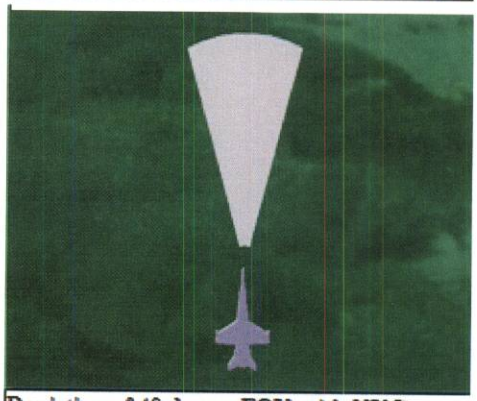


The ambient visual mode processes motion and orientation cues from the visual scene. While approaching the terrain during the day with unaided (non-NVG) vision, increased optical flow - the rapid movement of visual information across the retina - can produce a sense of "ground rush" through ambient vision. Normal field of view (FOV) is 120 degrees laterally by 80 degrees vertically, and binocular NVGs reduce FOV to 40 degrees. This reduction in FOV limits ground rush cues at night.

Example of person wearing binocular NVGs



Simulated NVG view 2.0 nm from impact on a 30 degree dive angle



Depiction of 40 degree FOV with NVGs

Expectancy

Expectancy is a factor when the individual expects to perceive a certain reality and those expectations are strong enough to create a *false perception* of the expectation.

The MC expected to have 10-15 seconds of track time before opening fire. The time between when the MA was established on final and impact was approximately 10 seconds. From impact, descending at 420 ft per second, it would have taken 5 additional seconds to reach the anticipated open fire altitude. Approximately 3 seconds prior to impact, the GCWS alerted the MC with four "pull-up" aural warnings, while displaying an upward pointing arrow on the MPDs and HUD. There is roughly a one second delay from the time the object falls on the peripheral retina until it is fixated upon and recognized, then an additional 1.5 second delay for action to change the course of the aircraft (total delay of 2.5 seconds). Expectancy can extend reaction time. (Tab DD-3, #5) This is relevant in accounting for the MC's failure to respond to the GCWS warnings.

Fatigue - Physiological/Mental

Fatigue - physiological/mental is a factor when the individual's diminished physical or mental capability is due to an inadequate recovery, as a result of restricted or shortened sleep or physical or mental activity during prolonged wakefulness. Fatigue may additionally be described as acute, cumulative or chronic.

There are several factors that suggest the MC was fatigued at the time of the mishap. The MC's misperception of operational conditions and channelized attention may be attributed to fatigue. Also, the communication between the MP and MW reveal some signs of fatigue. There was little communication between them, much less than would ordinarily be expected between a pilot and WSO flying a strafe attack. This was especially evident with no intra-cockpit communication after the MC began their attack. Much of the communication that did exist between the MP and the MW was not constructive. (Tab N-10 thru N-13)

The AIB input the information from the reconstructed 72-hour histories of the MP and the MW into the Fatigue Avoidance Scheduling Tool (FAST) to estimate the MC's cognitive effectiveness at the time of the mishap. (Tab DD-7, DD-9) The FAST is a tool developed for the U.S. Air Force and U.S. Army based on the widely used Sleep, Activity, Fatigue, and Task Effectiveness Model. Since not all information was available for the MP or the MW, a "best case" scenario was input into the FAST. The FAST estimated the MP's level of cognitive effectiveness at the time of the mishap was 71%, and the MW was at 72%. (Tab DD-10, DD-11) Any value below 77.5% is considered degraded.

Additionally, the FAST estimated the circadian nadir, or low point in cognitive effectiveness, for both flight members would have been at approximately 0300L. (Tab DD-10, DD-11) Thus, the MP and MW were nearing their lowest point of cognitive effectiveness just prior to the mishap. Fatigue is associated with decreased motivation and impairments to high-level cognition, decision making, situational awareness, multi-tasking capability, vigilance, and reaction time. (Tab DD-3, #1, 3) Studies show that humans operating on night schedules are significantly more error prone during the early morning hours. (Tab DD-3, #6, 7)

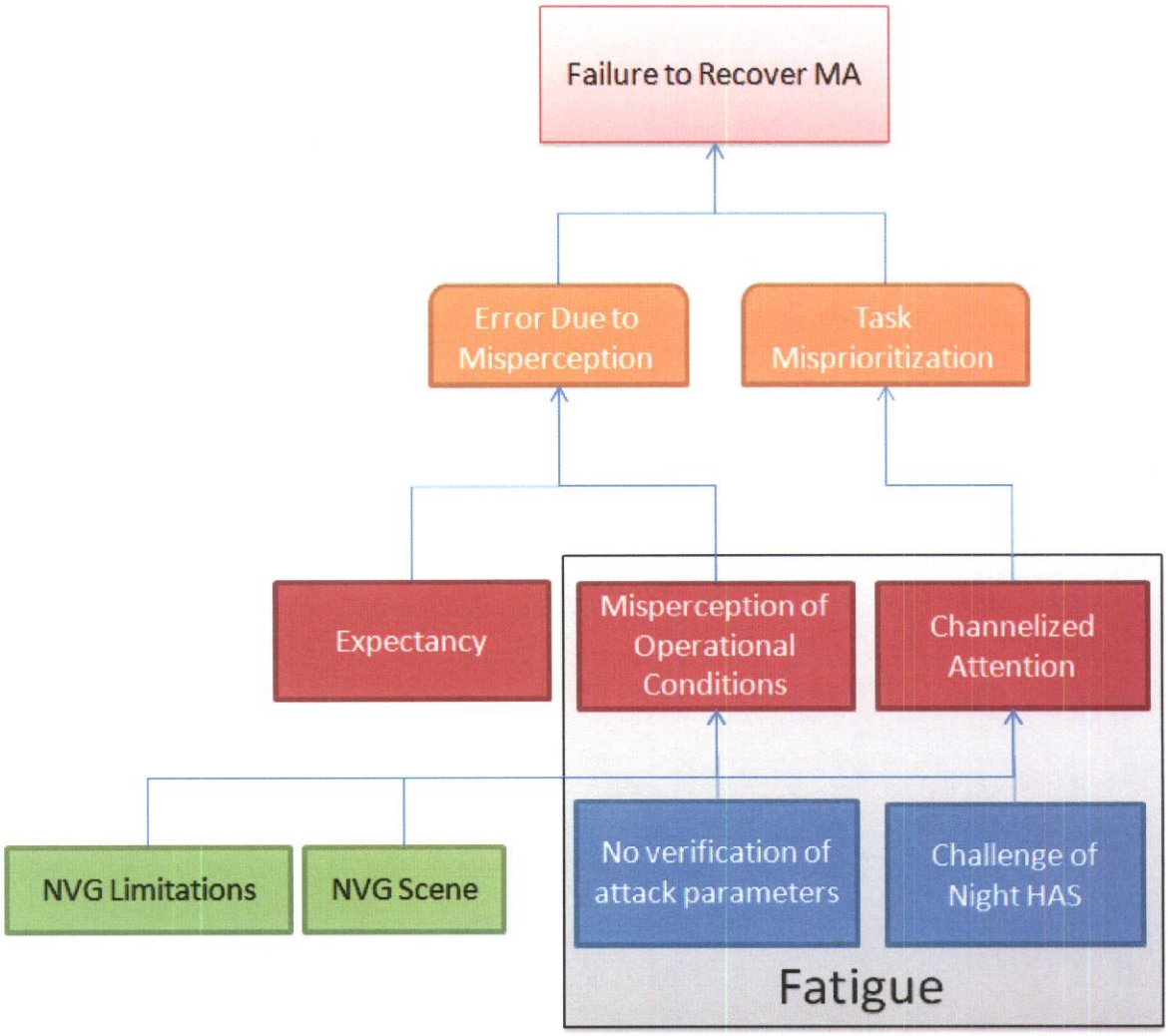
There are some factors that cause fatigue but are not accounted for in the FAST. One factor is acute fatigue experienced during the mission. The MC was in the aircraft for approximately 5 hours and 43 minutes prior to impact. Another factor absent from the FAST analysis is fatigue caused by NVGs due to eye strain and the extra weight of the device. The MC was wearing NVGs for the entire flight.

Task Misprioritization

Task misprioritization is a factor when the individual does not organize, based on accepted prioritization techniques, the tasks needed to manage the immediate situation.

The MW had flight parameters in the rear cockpit on his MPD including the radar altimeter that showed height above terrain. The facts indicate he misprioritized tasks on final that could have prevented the mishap.

Depiction of Human Factors Relevant to the Mishap



12. GOVERNING DIRECTIVES AND PUBLICATIONS

a. Primary Operations Directives and Publications

1. Air Force Instruction (AFI) 11-2F-15E, Volume 1, *F-15E--Aircrew Training*, 9 January 2007
2. AFI 11-2F-15E, Volume 2, *F-15E--Aircrew Evaluation Criteria*, 9 December 2005, Incorporating Change 1, 7 April 2008
3. AFI 11-2F-15E, Volume 3, *F-15E--Operations Procedures*, 25 October 2005
4. AFI 11-202, Volume 3, *General Flight* Rules, 5 April 2006
5. AFI 11-214, *Air Operations Rules and Procedures*, 22 December 2005, Incorporating Through Change 2, 2 June 2009
6. AFI 11-301, Volume 1, *Aircrew Flight Equipment (AFE) Program*, 25 February 2009
7. AFI 11-418, *Operations Supervision*, 21 October 2005
8. AFI 48-123, Volume 3, *Medical Examinations and Standards-Flying and Special Operational Duty*, 5 June 2006
9. AFI 51-503, *Aerospace Accident Investigations*, 16 July 2004
10. AFI 91-204, *Safety Investigations and Reports,* 24 September 2008
11. Air Force Tactics, Techniques and Procedures (AFTTP) 3-3.F-15E, *Combat Aircraft Fundamentals F-15E*, 18 March 2008
12. Technical Order (T.O.) 1F-15E-1, *F-15E Flight Manual*, 15 July 2002 with Change 10 dated 1 July 2008
13. T.O. 1F-15E-34-1-2, *F-15E Nonnuclear Weapon Delivery Manual*, 15 March 2006 with Change 4 dated 1 July 2008
14. Joint Publication 3-09.3, *Joint Tactics, Techniques, and Procedures for Close Air Support*, 8 July 2009
15. *Strike Eagle Attack Guide*, April 2009 (Draft)

b. Maintenance Directives and Publications

1. AFI 21-101, *Aircraft and Equipment Maintenance Management*, 29 June 2006
2. AFI 21-124, *Oil Analysis Program*, 4 April 2003
3. T.O. 00-20-1, *Aerospace Equipment Maintenance Inspection, Documentation, Policies and Procedures*, 30 April 2003 with Change 4 dated 1 September 2006
4. T.O. 42B-1-1, *Quality Control of Fuels and Lubricants*, 1 August 2004 with Change 1 dated 1 June 2005

NOTE: The AFIs listed above are available digitally on the AF Departmental Publishing Office internet site at: **http://www.e-publishing.af.mil.**

c. Known or Suspected Deviations from Directives or Publications

The FL did not correctly adhere to the warning in T.O. 1F-15E-1 with Change 10, page 1-218, which states, "Height Above Terrain (HAT) information on the TSD should not be used for absolute altitude reference for terrain avoidance or terrain clearance." Otherwise, there are no known or suspected deviations from directives or publications by any of the flight members or others involved in the mishap.

13. NEWS MEDIA INVOLVEMENT

Headquarters United States Forces Afghanistan (USFOR-A) Public Affairs (PA) and U.S. Air Forces Central Air Force Forces (AFCENT AFFOR) PA issued initial press releases. (Tab CC-14 thru CC-17) Local, national and international media outlets immediately reported on the mishap. (Cross-section of articles provided in Tab CC-18 thru CC-27) There has been significant media interest. The 4th Fighter Wing Commander held a press conference on 19 July 2009. (Tab CC-23 thru CC-25)

11 September 2009

H.D. POLUMBO, JR., Brigadier General, USAF
President, Accident Investigation Board

STATEMENT OF OPINION

F-15E, T/N 90-0231
BAGRAM AIRFIELD, AFGHANISTAN
18 JULY 2009

Under 10 U.S.C. 2254(d), any opinion of the accident investigators as to the cause of, or the factors contributing to, the accident set forth in the accident investigation report may not be considered as evidence in any civil or criminal proceeding arising from the accident, nor may such information be considered an admission of liability of the United States or by any person referred to in those conclusions or statements.

1. OPINION SUMMARY

On 18 July 2009 at approximately 0233 local time, an F-15E flown by two officers assigned to the 336th Expeditionary Fighter Squadron at Bagram Airfield impacted the ground 30 miles west of Ghazni, Afghanistan. The mishap sortie was a close air support combat mission in support of Operation ENDURING FREEDOM. The crash occurred in a mountainous area with peaks as high as 16,000 feet. The mishap crew died upon impact, and the mishap aircraft was destroyed. No other injuries or damage resulted from the mishap.

I find by clear and convincing evidence the cause of the mishap was the flight lead weapon systems officer's incorrect assessment of the target elevation and the mishap crew's reliance on this inaccurate number. These actions resulted in strafe attack parameters for open and cease fire altitudes that were below the actual ground level of the target.

I also find sufficient evidence to conclude the following five factors substantially contributed to the mishap: misperception of the operational conditions in the target area; an erroneous expectation for a typical night strafing attack; inexperience by the flight lead and the mishap crew at executing night strafing; channelized attention; and an improper cross check during the attack.

2. DISCUSSION OF OPINION

a. Background

All flight members involved in the mishap were highly motivated and qualified for their designated crew positions. They were, however, relatively inexperienced in the combat air force. The flight lead pilot completed his upgrade training just prior to deployment and had only led formations since May 2009. The flight lead weapons system officer (WSO) completed instructor training just prior to deployment but had not flown any missions as an instructor due to actual combat operations in Afghanistan. The mishap pilot and WSO were new to the F-15E weapon system and were on their first combat rotation. The mishap pilot was on his way to an early upgrade to flight lead status, and squadron leadership thought highly of him. The mishap WSO was a smart, energetic new aviator who worked very hard under additional supervision to prepare for his first combat tour. These two officers had little experience at night strafe in low illumination conditions.

The days leading up to the mishap were very busy for the mishap crew, but both had a day off from flying duties before the mishap sortie. Fatigue was relevant to the mishap since it occurred at the end of a combat mission and during the most difficult part of the circadian cycle. All members of the mishap flight had, however, settled into their battle rhythm since they were in the third month of their deployment.

Mission preparation, briefing, ground operations and takeoff were all uneventful. The close air support portion of the mission was also uneventful.

b. Cause

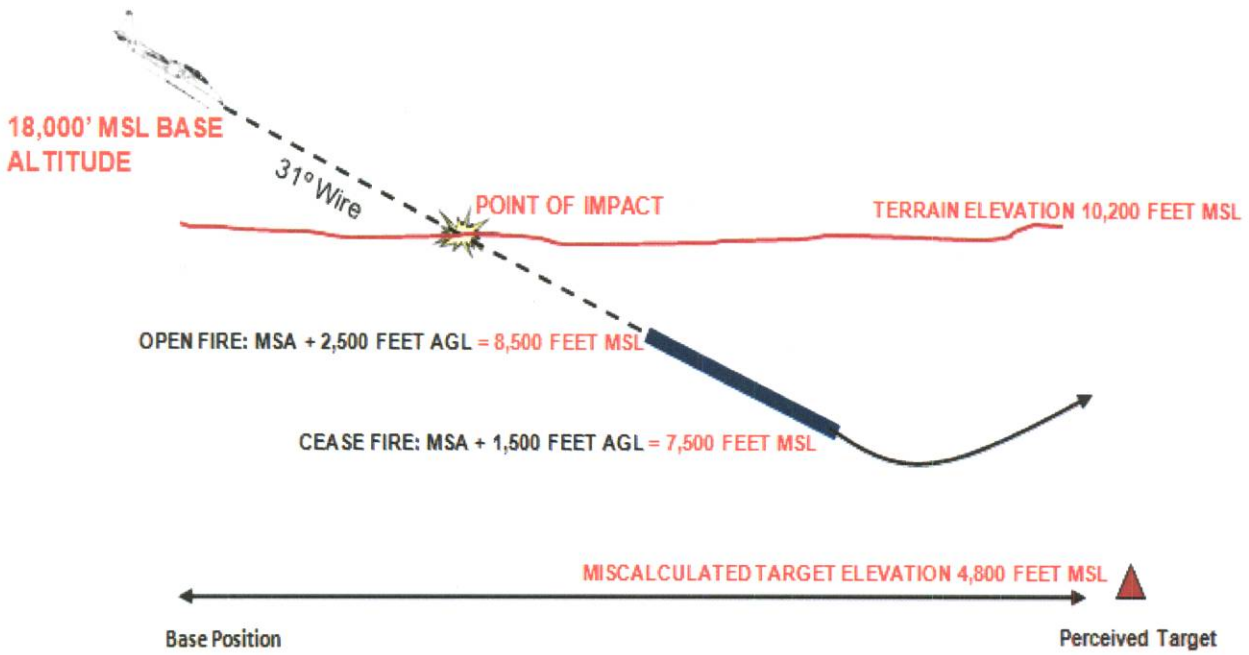
After completing their close air support mission, the flight lead weapon systems officer set steering in the tactical situational display (TSD) to Bagram Airfield. The TSD screen displayed an elevation of approximately 4,800 feet mean sea level (MSL) for the airfield. He then moved the steering cursors to the dry lake bed to assess the elevation of the target area but the TSD screen displayed "DTED [Digital Terrain Elevation Data] NOT AVAILABLE." It took only a few seconds to move the cursors to the intended target. He then told the flight lead pilot the average terrain for the dry lake bed was 4,800 feet, and the flight lead pilot passed this information to the mishap crew. The actual elevation of the dry lake bed was 10,200 feet. The flight lead weapon systems officer most likely determined the incorrect elevation information by recalling the 4,800 feet elevation from Bagram Airfield that was momentarily displayed before the cursors were moved over a point on the dry lake bed.

The mishap crew relied on this incorrect information without verifying it in their own cockpits. The inaccurate target elevation resulted in strafe attack parameters below the actual ground level of the intended target.

c. Substantially Contributing Factors

Squadron leadership took appropriate actions to ensure aircrew were prepared to strafe safely at night and in mountainous terrain. After considering the meteorological conditions in the target area, the flight lead directed the use of low illumination attack parameters. The flight lead incorrectly determined the target elevation as 4,800 feet MSL, and all flight members acknowledged this input. A flight lead is responsible for the safe conduct of all operations by each member of the formation. Wingmen are expected to follow the leader's direction, but they are also responsible for verifying data and attack parameter calculations.

The mishap crew used the inaccurate target elevation data to calculate open and cease fire attack parameters of 8,500 and 7,500 feet MSL respectively. These numbers were below the actual target elevation of 10,200 feet MSL.



The flight lead initiated his attack but aborted due to a shallow dive angle. He radioed to his wingman that he aborted his attack due to the shallow angle but did not provide additional information. The mishap crew did not acknowledge this radio call and did not make any adjustments to their attack parameters.

Following this chain of events, the mishap crew maneuvered for their attack expecting approximately 10-15 seconds of track time on final prior to reaching the planned open fire altitude. Less than optimum conditions under night vision goggles led to the mishap crew's misperception of their operational conditions for a strafing attack. They had additional opportunities to correct their attack parameters using a proper cross check of other information, but instead channelized their attention on the pipper and specific targeting information while ignoring ground proximity cues. The aircraft's ground collision warning system alerted the mishap crew to 'pull up' four times but they were unable to process the information in a timely manner before impacting the ground. Video of the mishap crew's strafe attack from the flight lead's aircraft revealed no attempt to recover the aircraft. Analysis of the ejection seat components revealed no attempt to eject.

3. CONCLUSION

Night high angle strafe using night vision goggles in mountainous terrain is one of the most difficult tasks any F-15E crew, experienced or inexperienced, must do over the course of their career. The mishap pilot and weapon systems officer were dedicated warriors who lost their lives trying to remain proficient at an attack necessary to save other Americans' lives on the ground during important battles in Afghanistan. The mishap sortie was conducted in accordance with applicable service and unit guidelines, and the mishap pilot and weapon systems officer were current and qualified to perform the planned mission events.

All four members of the mishap flight had opportunities to correct their assessment of target elevation, but tragically no one caught the mistake and the mishap crew did not recover from the flawed high angle strafe attack.

11 September 2009

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